

Claims

We claim:

1. A feature that is useful to align and assemble a photonic package, the photonic package having a first photonic component and a second photonic component, the feature comprising:

the first photonic component, the first photonic component having a first housing, the first housing having a partially spherical surface for providing mechanical contact with the second component; and

the second photonic component, the second photonic component having a second housing, the second housing having a contact surface, the contact surface for providing mechanical contact with the partially spherical surface along at least one circular contact line, whereby the feature enables the alignment and affixing of the first photonic component with the second photonic component while maintaining mechanical contact of the first photonic component with the second photonic component.

2. The feature of claim 1, wherein the first photonic component is substantially symmetric with respect to an optical axis of the first component.

3. The feature of claim 2, wherein the second photonic component is substantially symmetric with respect to at least one optical axis of the first photonic component.

4. The feature of claim 1, wherein the first photonic component is asymmetric with respect to an optical axis of the first component.

5. The feature of claim 4, wherein the second photonic component is asymmetric with respect to at least one optical axis of the first photonic component.

6. The feature of claim 1, wherein the contact surface is comprised within a cylindrical channel.

7. The feature of claim 6, wherein the cylindrical surface has a niche, the niche for constraining the linear motion of the partially spherical surface when the partially spherical surface is inserted into the cylindrical channel.

8. The feature of claim 7, wherein the niche is dimensioned to allow a range of motion of the partially spherical surface along one linear axis.

9. The feature of claim 1, wherein the contact surface is comprised within a cone.

10. The feature of claim 1, wherein the first photonic component further comprises at least one photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped

mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

11. The feature of claim 1, wherein the second photonic component further comprises a second photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

12. The feature of claim 11, wherein the first photonic component further comprises a first photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

13. The feature of claim 1, wherein the feature further comprises a layer of a material, the layer of material for affixing the partially spherical surface to the contact surface, and the layer of material substantially positioned between the partially spherical surface and

the contact surface, and the material useful for affixing the partially spherical surface to the contact surface.

14. The feature of claim 13, wherein the layer of material is selected from the group consisting of adhesive, welding material, solder and epoxy.

15. The feature of claim 1, wherein the first housing has a thinned edge, the thinned edge for conducting an electrical current, and the thinned edge brazing with the contact surface while conducting the electrical current, whereby the first housing is affixed to the second photonic component.

16. The feature of claim 1, wherein the second housing has a thinned edge.

17. The feature of claim 1, wherein the first housing comprises at least one hole, the hole for use in delivering a material useful for forming the photonic package.

18. The feature of claim 17, wherein the material is selected from the group consisting of adhesive, welding material, solder and epoxy.

19. The feature of claim 1, wherein the first photonic component and the second photonic component are affixed together by a process selected from the group consisting of adhering, adhering with epoxy, soldering, welding, solid phase welding, thermal

compression welding, acoustic welding, spot welding, spark welding, laser welding, electrical welding and mechanical contact welding.

20. The feature of claim 1, wherein the second photonic component further comprises a plurality of photonic elements, each photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

21. The feature of claim one, wherein the feature further comprises:

a third photonic component, the third photonic component having a third housing, the third housing having an ancillary partially spherical surface for providing mechanical contact with the second component; and

the second housing of the second photonic component having a second contact surface, the second contact surface for providing mechanical contact with the ancillary partially spherical surface of the third photonic component along at least one circular contact line, whereby the feature enables the alignment and affixing of the third photonic component with the second photonic component while maintaining mechanical contact of the third photonic component with the second photonic component.

22. A feature that is useful to align and assemble a photonic package, the photonic package having a first photonic component and a second photonic component, the feature comprising:

the first photonic component, the first photonic component having a first housing, the first housing having a partially spherical surface for providing mechanical contact with the second component; and

the second photonic component, the second photonic component having a second housing, the second housing having a contact surface, the contact surface for providing mechanical contact of a contact area of the contact surface with the partially spherical surface, whereby the feature enables the alignment and affixing of the first photonic component with the second photonic component while maintaining mechanical contact of the first photonic component with the second photonic component.

23. The feature of claim 22, wherein the first photonic component further comprises a first photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

24. The feature of claim 22, wherein the second photonic component further comprises a second photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

25. The feature of claim 24, wherein the first photonic component further comprises a first photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

26. A feature that is useful to align and assemble a photonic package, the photonic package having a first photonic component and a second photonic component, the feature comprising:

the first photonic component, the first photonic component having a domed wall, the domed wall having a partially spherical convex surface for providing mechanical contact with the second component; and

the second photonic component, the second photonic component having a second housing, the second housing having a partially spherical concave contact surface, the partially spherical concave contact surface for providing mechanical contact of a contact area of the partially spherical concave contact surface with the partially spherical convex surface of the domed wall, whereby the feature enables the alignment and affixing of the first photonic component with the second photonic component while maintaining mechanical contact of the first photonic component with the second photonic component.

27. The feature of claim 26, wherein the first photonic component further comprises a first photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

28. The feature of claim 26, wherein the second photonic component further comprises a second photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a

shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

29. The feature of claim 28, wherein the first photonic component further comprises a first photonic element selected from the group consisting of a wave guide, a planar wave guide, a photonic crystal wave guide, a diffraction wave guide grating, an optical fiber, a collimator, a lens, a diffractive lens, an optical lens, a spherical lens, an aspherical lens, a ball lens, a GRIN lens, a C-lens, a lens system, a mirror, a flat mirror, a shaped mirror, a diffractive mirror, a grating plate or plates, a laser, a modulator, a photodiode, a VCSEL, and a prism.

30. A method of forming a photonic package by aligning and assembling two photonic components together, the method comprising:

providing a first photonic component, the first photonic component having a first housing, the first housing having a convex surface for providing mechanical contact with the second component;

providing a second photonic component, the second photonic component having a second housing, the second housing having a contact surface, the contact surface for providing mechanical contact with the convex surface along at least one contact line;

placing the partially spherical surface at least partially into mechanical contact with the contact surface;

aligning the first photonic component into a desired alignment with the second photonic component while maintaining the mechanical contact of the partially spherical surface with the contact surface; and

affixing the first photonic component and the second photonic component while the first photonic component and the second photonic component are in a desired alignment, whereby the invented method enables the alignment and affixing of the first photonic component with the second photonic component while maintaining mechanical contact of the first photonic component with the second photonic component.

31. The method of claim 30, wherein the convex surface is at least partially shaped from a shape selected from the group of a sphere, an ovoid or an ellipsoid.

32. The method of claim 30, wherein the contact surface is comprised within an at least partially cylindrical channel.

33. The method of claim 30, wherein the contact surface is comprised within an at least partially conical channel.

34. The method of claim 30, wherein the contact surface has an internal niche for constraining the movement of the convex surface in at least one linear degree of freedom.

35. The method of claim 30, wherein the photonic package is formed by affixing the first photonic component and the second photonic component together by a process selected from the group consisting of adhering, adhering with epoxy, soldering, welding, solid phase welding, thermal compression welding, acoustic welding, spot welding, spark welding, laser welding, electrical welding and mechanical contact welding.